

## PATENT COOPERATION TREATY

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An extrusion apparatus and method, a tubular product, and a pipe

5 The invention relates to an extrusion apparatus for processing plastic material to be extruded, the extrusion apparatus comprising

- at least one stator,
  - at least one rotor,
  - at least one annular feed gap situated between
- 10 the stator and the rotor for the plastic material to be extruded, the diameter of the gap decreasing at least partly continuously in the direction of flow of the plastic material to be extruded, and
- at least one actuator for rotating the rotor.

15 The invention further relates to an extrusion method wherein a product is extruded with an extrusion apparatus comprising at least one stator, at least one rotatable rotor that is at least partly conical, whereupon at least the surface of the stator situated on the side of

20 the rotor is conical at the conical section of the rotor, so that there is between the stator and the rotor an annular feed gap into which the plastic material to be extruded is fed and the diameter of which feed gap decreases at least partly continuously in the direction of

25 flow of the plastic material to be extruded.

The invention also relates to a tubular product and a pipe made of several different materials.

In this type of extrusion apparatus, pressures are high and mechanical stresses are great in the nozzle

30 section, i.e. in the area of the central extrusion conduit. The present structures also needlessly prevent some of the possibilities of use of the apparatus.

The purpose of the present invention is to eliminate this drawback. This object is achieved with the

35 extrusion apparatus arrangement according to the

invention, which is mainly characterized in that the diameter of the feed gap increases continuously at least at a section of its length in the direction of flow of the plastic material to be extruded.

5 Further, the extrusion method according to the invention is characterized in that the diameter of the feed gap increases continuously at least at a section of its length in the direction of flow of the plastic material to be extruded, whereupon the plastic material is  
10 extruded at least at a section of the way outwards under the control of the feed gap.

Also, the tubular product according to the invention is characterized in that the outer layer of the product is made of metal or plastic-coated metal, inside  
15 which outer layer there is at least one layer of plastic, and between the outer layer and at least one plastic layer there is adhesion plastic which is foamed at least in one intermediate layer.

The pipe according to the invention is  
20 characterized in that the innermost layer is a plastic layer, outside of which there is an inner electrode layer, outside of which there is an insulating layer, outside of which there is an outer electrode layer.

With the nozzle construction according to the  
25 invention which expands outwards and in which the feed gap enlarges after it has contracted, the pressure acting on the structures of the extrusion apparatus can be considerably balanced, i.e. the apparatus can be made more durable.

30 Also, especially if the feed gap opens on the outer circumference of the extrusion apparatus or near it, it is highly preferable that an actuator provided for each rotor and the means of the actuator driving the rotor are placed at the back of the extrusion apparatus in such a  
35 way that the actuator is positioned in the radial

direction of the extrusion apparatus within the outlines determined by the other components of the extrusion apparatus. In such a case, the extrusion apparatus can be easily made such that the nozzle section determines the  
5 outer dimensions of the entire extrusion apparatus in the radial direction, whereupon the possibilities of use of the apparatus increase considerably.

A new possibility presents itself for example when the extrusion apparatus is connected to operate  
10 together with a corrugator used for preparing for example corrugated pipes, and the extrusion apparatus can be placed inside the corrugator altogether. At present, material must be fed into the corrugator with a long nozzle, so that the material travels in the apparatus for  
15 a long time and a great amount of stabilizer is needed. When used with a corrugator, the extrusion apparatus can also be formed with a double cone structure in order to manufacture a two-layer corrugated pipe.

Placing the actuator(s) at the back of the  
20 extrusion apparatus also enables the use of the apparatus at the rear of a hole-making machine for example underground, whereupon the extrusion apparatus is arranged to prepare a plastic pipe in the hole made by the machine. The fact that it is very easy to construct the conical  
25 extruder in such a way that there is a considerable hole through the extruder makes the connection to the hole-making machine easy. Another new possibility results from the fact that the extrusion apparatus can also be used for coating e.g. steel pipes from the inside. In such a case,  
30 the inner surface of a steel pipe can be simultaneously coated with thermally insulating adhesion plastic and with an inner layer made of for example PEX placed inside the adhesion plastic. Such pipes can be joined for example with a cross-linked plastic sleeve.

In all embodiments where the actuators are situated at the back of the extrusion apparatus, the supply of the plastic material to the apparatus must naturally also be arranged from the rear.

5 In the following, the invention will be described in greater detail with reference to the accompanying drawings, in which

Figure 1 is a cross-sectional side view of a simple embodiment of an extrusion apparatus provided with  
10 a radially expanding nozzle section,

Figure 2 is a cross-sectional side view of another embodiment of an extrusion apparatus where the rotating mechanisms for the rotors are placed at the back of the extrusion apparatus,

15 Figure 3 is a cross-sectional side view of a third extrusion apparatus placed inside a corrugator,

Figure 4 shows a detail of the apparatus of Figure 3,

20 Figure 5 shows an extrusion apparatus moving at the rear of an underground hole-making machine and preparing a plastic pipe in the hole made by the machine,

Figure 6 is a cross-sectional view of a pipe coated with the apparatus of Figure 5,

25 Figure 7 is a cross-sectional side view of a fourth extrusion apparatus according to the invention,

Figure 8 shows a detail of the apparatus of Figure 7,

30 Figure 9 shows the coating of a pipe from the outside and the inside with two different extrusion apparatuses, and

Figure 10 shows the coating of a pipe positioned in place from the inside with an extrusion apparatus,

35 Figure 1 shows a simple extrusion apparatus for extruding plastic material, in which case the plastic material is fed into the apparatus either in a fixed,

preferably powdery or granular, form or either entirely or partly melted. This extrusion apparatus comprises an outer stator 1, a rotor 2, an inner stator 6, an annular feed gap 3 situated between the outer stator 1 and the rotor 2, and correspondingly another annular feed gap 3 situated between the inner stator 6 and the rotor 2 for the plastic material to be extruded, and an actuator 5 for rotating the rotor 2.

The rotor 2 is conical, and the surfaces of the stators 1 and 6 are conical at least on the side of the rotor 2, i.e. at least the inner surface of the outer stator 1 and the outer surface of the inner stator 6 are conical. The actuator 5 comprises a motor and for example a pinion system or a gear system. The motor may be for example a hydraulic motor, an electric motor or some other motor that is known per se and that is suitable for the purpose. Hydraulic drive is particularly advantageous for example when the extrusion apparatus is used in connection with an underground hole-making machine, in which case the hole-making machine and the extrusion apparatus may share the power supply. If the actuator 5 comprises a gear system, the speed of rotation of the rotor 2 can be adjusted with the system in a desired manner. On the other hand, for example when an electric motor is used the gear system is not necessary, since the speed of rotation of the rotor 2 can be regulated easily by adjusting the speed of rotation of the motor in a manner known per se.

The extruder further comprises a supply conduit 7 along which the material to be extruded can be fed into the feed gap 3. The material to be fed into the supply conduit 7 is supplied by a feeding device 8. The feeding device 8 can be for example a feed screw, a pump or some other device known per se. With the feeding device, the flow rate of the material to be fed into the supply conduit can be adjusted. The material to be supplied can

be conducted from the supply conduit 7 to the feed gap 3 between the outer stator 1 and the rotor 2. The rotor 2 further comprises openings 9 via which some of the material situated in the supply conduit 7 can flow into the interior of the rotor 2 into the feed gap 3 between the inner stator 6 and the rotor 2. It is also possible to use separate supply conduits and feeding devices for separately feeding the material to be supplied into the exterior and interior of the rotor 2 in a manner known per se. When the rotor 2 is rotated, the material to be extruded flows in the direction of flow A in the extrusion apparatus by the action of grooves provided in the rotor 2 and/or in the stators. For the sake of clarity, these grooves are not shown in the figure.

The diameter of the annular feed gap 3 decreases at first continuously in the direction of flow A of the plastic material to be extruded, and the feed gap comprises firstly a feed zone 3a, then a melting zone 3b and at the end a compression zone 3c in the aforementioned direction of flow A. After the rotor 2, the feed gaps 3 provided on different sides of the rotor 2 come together as one feed gap 3. In order to balance the pressures P and the stresses, the diameter of the central feed gap 3 correspondingly increases continuously at a section of the length of the gap in the direction of flow A of the plastic material to be extruded after the feed gaps 3 from the different sides of the rotor 2 have come together as one feed gap 3. In this exemplary embodiment, the diameter of the feed gap 3 increases linearly immediately after the rotor 2, and the end section of the gap has a constant diameter, i.e. the gap is parallel with the central axis of the extrusion apparatus.

Figure 2 is a cross-sectional side view of a second extrusion apparatus according to the invention. The reference numerals in Figure 2 correspond to those in



Figure 1. The extruder according to Figure 2 comprises two conical rotors, an outer rotor 2a being placed between an outer stator 1 and an intermediate stator 10 and an inner rotor 2b being placed between an inner stator 6 and the intermediate stator 10. For the sake of clarity, the figure does not show grooves provided in the rotors and/or the stators. An actuator 5 is arranged to rotate the rotors 2a and 2b. The speeds of rotation of the rotors 2a and 2b can be adjusted differently, if desired, and/or their speeds of rotation can be made adjustable independently of each other. Material is supplied to feed gaps 3 situated on the outside and inside of the outer rotor 2a by means of a supply conduit 7 and a feeding device 8. Correspondingly, material is supplied to the interior of the inner rotor 2b and via openings 13 to the exterior of the rotor by means of a second supply conduit 11 and a second feeding device 12.

The feed gap 3 opens on the outer circumference of the extrusion apparatus. The actuator 5 and the feeding devices 8 and 12 are placed at the back of the extrusion apparatus in such a way that they are positioned in the radial direction of the extrusion apparatus within the outlines determined by the outermost point of the feed gap 3 of the extrusion apparatus, this outer circumference being denoted in the accompanying figure by  $\phi_u$ .

Figure 3 shows a third extrusion apparatus according to the invention placed inside a corrugator. The reference numerals in Figure 3 correspond to those in Figures 1 and 2. The corrugator comprises chill moulds 14 that move forward and that have a grooved inner surface against which the plastic mass 15 is pressed in order to prepare a ribbed pipe. Since the structure of the corrugator is known per se, it will not be discussed in greater detail in this connection. The feeding device 8 and the actuator 5 for rotating the rotor 2 are placed at

the back of the extrusion apparatus in such a way that they are positioned in the radial direction inside the outermost part of the feed gap 3, i.e. inside the outer circumference  $\varnothing_u$ . The extrusion apparatus can then be placed inside the corrugator, and there is no need for long nozzles where the plastic mass 15 easily cools too much before arriving at the grooves of the chill moulds 14. The initial section of the rotor 2 has the shape of a tapering cone and the end section of the rotor has the shape of an expanding cone. The rotor 2 thus forms on each side separate feed gaps 3 that extend to the outer circumference  $\varnothing_u$  of the extrusion apparatus. The rotor 2 comprises grooves 4 that transport the material to be extruded out from the extruder. However, at the end of the rotor 2 there is a smooth area comprising no grooves. The material to be extruded thus forms a smooth flow and comprises substantially no seams produced by the grooves. Further, the groove-free area produces and maintains a helical orientation field. This orientation is frozen into the product when the parison to be extruded meets the chill moulds.

At the bottoms of the grooves of the chill moulds 14, there are suction ducts 16 the suction of which ensures that the plastic mass 15 reaches all the way to the bottom of the grooves of the chill moulds 14. Further, by suitably conducting the material flows of the plastic mass 15 flowing on different sides of the rotor 2, it is possible to produce a pipe comprising openings 17 at the grooves of the chill moulds. The extrusion apparatus further comprises a mandrel 18, and the plastic pipe is formed as the chill moulds 14 and the mandrel 18 press the plastic pipe preform from different sides.

Figure 4 shows a detail of the apparatus of Figure 3. The reference numerals in Figure 4 correspond to those in Figures 1 to 3. Figure 4 shows clearly how the

apparatus produces an opening 17 in the corrugated pipe. The plastic mass flows 15a and 15b are conducted in such a way that the plastic pipe to be extruded will comprise two layers. Instead of the suction ducts 16, the opening 17 could be formed by means of blowing that is arranged to blow air or some other suitable gas through the rotor 2 in order to produce the opening 17.

Figure 5 shows schematically an extrusion apparatus according to the invention placed in connection with an underground hole-making machine. The hole-making machine 20 is arranged to make a hole in the soil 21. The extrusion apparatus 19 in turn is arranged to move in connection with the hole-making machine 20 and to simultaneously produce a plastic pipe 22 in the hole made by the hole-making machine 20. The control and actuator connections 23 of the hole-making machine 20 can be made to pass through the hollow extrusion apparatus 19. For the sake of clarity, Figure 5 does not show the means required for moving the hole-making machine 20 and the extrusion apparatus 19.

Figure 6 shows a steel pipe which is coated with plastic from the inside and in which the layer situated against the steel 24 is thermally insulating adhesion plastic 25 and the second layer is cross-linked polyethylene, i.e. PEX 26. The adhesion plastic 25 can be for example grafted polyethylene. The adhesion plastic 25 is preferably foamed. When the steel pipe is coated from the inside, the coating plastic is hot in the beginning so that its diameter remains large, whereas when the plastic cools the diameter of the plastic layer tends to decrease. The foamed adhesion plastic 25 sticks to the surface of the steel pipe but allows the inside to shrink. In such a case, the foam bubbles stretch in the radial direction, i.e. the foam bubbles are oriented radially, which increases the strength of the pipe. The foamed adhesion

plastic 25 comprises preferably at least 10%, most preferably about 25%, of fine filling agent, such as calcium carbonate. The elastic modulus of the foam can thus be made high, i.e. the structure will be strong.

5 Further, the foamed adhesion plastic 25 is a very good heat insulator against the PEX 26. On the other hand, when a steel pipe is coated from the inside, the orientation of the plastic pressed inside can be frozen efficiently, since the steel pipe cools the pipe effectively from the

10 outside. When steel pipes coated in this manner are to be joined together, for example a cross-linked plastic sleeve 27 that is compressed and warmed in place can be used. The cross-linked plastic sleeve 27 tends to return to the size of the diameter preceding the compression, and the

15 expansion is provided by means of heating. The joint will then be extremely tight. It is also possible to use for the joint a sleeve 28 that is provided in the outside with mastic or some other adhesive with which the sleeve 28 can be made to stick to the pipe. Electrofusion can also be

20 used. At the outside of the joint, it is possible to place a clamping collar 29 that is made of a strong material and that can be positioned to rest on a metal casing, such as steel 24. The clamping collar 29 receives axial tensile forces. The joint can also be implemented by welding, so

25 that the adhesion plastic 25 acts as a good heat insulator against the innermost layer. The coating of steel pipes can be realized by applying the principle shown in Figure 5. Other metal pipes and concrete pipes can also be coated in a similar manner.

30 Figure 7 is a cross-sectional side view of an extrusion apparatus according to the invention. The reference numerals in Figure 7 correspond to those of Figures 1 to 6. The extrusion apparatus of Figure 7 comprises one fixed stator, an intermediate stator 10. At

35 the outside of the stator there is a rotatable outer rotor

2a and at the inside there is a rotatable inner rotor 2b. The surface of the intermediate stator 10 on the side of the outer rotor 2a is conical and correspondingly the surface of the outer rotor 2a on the side of the intermediate stator 10 is conical. The intermediate stator 10 comprises grooves 4 that transport the material to be extruded between the intermediate stator 10 and the outer rotor 2a out of the extrusion apparatus as the outer rotor 2a rotates. According to a corresponding principle, the inner rotor 2b comprises grooves that transport the plastic material to be extruded out of the extrusion apparatus as the inner rotor 2b rotates. For the sake of clarity, the accompanying figure only shows an actuator 5 rotating the outer rotor 2a. For the inner rotor 2b there may be one or several actuators. It is also possible to place one common actuator to rotate both the outer rotor 2a and the inner rotor 2b, whereupon each rotor is rotated by the same pinion so that the rotors naturally rotate in opposite directions. If each rotor has its own actuator, the directions of rotation of the rotors can naturally be selected to be the same or opposite. The inner rotor 2b is followed by a rotatable expansion cone 30. The expansion cone 30 is rotated with a rotating means 31. With the rotating means 31 the expansion cone 30 can be rotated either at the same or a different speed with the inner rotor 2b in the same or different direction according to the desired orientation. The extrusion apparatus according to the invention is arranged to prepare the innermost pipe of a multilayer pipe and the apparatus comprises means for producing the outer layer of the pipe, the means preparing the outer layer by winding a strip 32 spirally into a pipe. These means are not shown in the figure for the sake of clarity. The extrusion apparatus of Figure 7 makes the plastic mass 15 of the inner pipe move in a rotating manner so that the layers can be caused to stick together

very well. The mandrel 18 may also be cooled, so that as the strip 32 and the mandrel 18 cool the plastic mass 15, the orientation of the mass can be frozen very efficiently. The strip 32 may be made of for example glass fibre or it may be a polypropylene strip oriented in one direction.

The strip 32 preferably consists of an outer electrode layer 32a, an insulating layer 32b and an inner electrode layer 32c. The outer electrode layer 32a can be made of for example electrically conductive plastic or aluminium foil. The insulating layer 32b can be for example sintered or normal foamed plastic the cells of which comprise for example a filler. The foamed plastic is preferably contains holes so that for example air passes through it. The inner electrode layer 32c can have a similar structure as the outer electrode layer 32a. The above-described manner provides a pipe that can be used for example in such a way that as a nail passes through the pipe, a short circuit occurs between the electrode layers and the pipe warns the user of a serious breakdown. The pipe can be used for example as a gas pipe inside a building. On the other hand, a potential difference can be created between the electrode layers, whereupon as the surface of the pipe is pressed in some place for example by a stone, the change in the potential difference of the insulating layers can be detected by a voltmeter. The application of the pipe is useful for example when laying the pipe in the ground, and for example problems caused by an excessive traffic load can be taken into account in such a situation. In the same way, it is possible to detect an excessive increase of the pressure inside the pipe. The alarm levels of the pipe can be determined easily by adjusting the outside ring stiffness of the pipe with respect to the inside stiffness and to the hardness of the foam. On the other hand, when the pipe is used as a

ventilation or a soil and waste pipe inside a building, noise of the sewer in the pipe can be detected and a counter-wave can be correspondingly produced in the outside to muffle the noise occurring in the pipe.

5 Further, it is possible to use the outer surface to produce a sound, for example a warning signal. The potential difference between the electrode layers can also be used as a moisture barrier, so that water molecules cannot corrode the surface of the pipe. Correspondingly,

10 when the insulating layer becomes damp, it affects the potential difference, wherefore the pipe can be used as a sensor for locating leakages for example in district heating pipes. The strength of the pipe is also excellent for example when aluminium is used for the electrode

15 layer. The electrode layers can naturally be used for example for electrically heating or for locating the pipe, since for example aluminium can be easily detected from the ground by means of e.g. a metal detector. On the other hand, sound signals can also be supplied to the electrodes

20 and the audible sound can be used to facilitate the location. The insulating or insulation foam layer situated between the electrodes can also be modified for example with carbon black so that it is partially conductive, whereupon the compression of the insulator directly

25 affects for example the potential difference. The application for use in sprinklers is also possible since the fast warming of the metal foil affects the electric connection between the films. Due to its great strength originating from the combination of metal and oriented

30 plastic and the possibilities of using alarm signals, the pipe is also applicable for offshore gas and oil pipes and for large trunk lines, for instance. It seems possible that by feeding high-frequency oscillation into a pair of electrodes, bacterial growth on the outer and/or inner

35 surface of the pipe can be prevented.

The electrode layers can be positioned in such a way that the outer electrode layer 32a is more rigid, whereupon the pipe reacts mainly to signals arriving from the inside, or in such a way that the inner electrode layer is more rigid, whereupon the pipe reacts mostly to signals from the outside.

The apparatus of Figure 7 can also be arranged to rotate as a whole by mounting the extrusion apparatus in bearings from the end so that it rotates, whereupon for example the accumulation of tolerances can be avoided in the manufacture of films. In this case, the material of the tubular product comes out from the extruder rotating, and naturally the haul-off must be of rotating type too. There may be wedges 43 outside the apparatus, the outer rotor 2a being moved in the radial direction by means of the wedges. In this way, the thickness of the outer layer of the plastic material 15 produced by the apparatus can be adjusted. The rotating cone 30 can be made axially movable, whereupon by changing the place of the rotating cone 30 it is possible to adjust the thickness of the inner layer of the material 15 to be extruded. By feeding the material to be extruded with separate supply conduits to different sides of the intermediate stator 10, the material flow can be adjusted by means of the feeding devices so that the material flows to be supplied to each side determine the thicknesses of the different layers. The outer rotor 2a, the inner rotor 2b and the expansion cone 30 preferably rotate in the same direction, whereupon the plastic material to be extruded is wound tightly together with the strip 32 to be supplied and the pipe to be extruded will form an even construction. The intermediate stator 10 comprises electric resistors 44, whereupon the material to be extruded can be heated mainly from the middle of the material through the intermediate



stator 10, so that the heating can be realized effectively.

Figure 8 shows a detail of the apparatus of Figure 7. The reference numerals in Figure 8 correspond to those in Figures 1 to 7. In the case of Figure 8, instead of the strip 32, an aluminium strip 33 is supplied to form the outer layer. The aluminium strip 33 can be attached to the adjacent aluminium profile in the spiral formed by the strip for example by means of a continuous weld, spot welding or gluing or in some other manner known per se. The aluminium strip 33 may also comprise grooves as shown in Figure 8. In such a case, the diameter  $\varnothing r$  of the outermost supply flow of the mass 15 to be supplied is made preferably greater than the smallest inner diameter  $\varnothing A1$  of the aluminium profile 33, whereupon the compression of the plastic mass 15 to the bottom of the grooves can be ensured and a very strong aluminium-coated plastic pipe can be manufactured. Instead of a flat aluminium profile, the profile can be of plastic material having e.g. a hollow square cross-section which will greatly enhance the ring stiffness of the pipe. This type of stiff pipe with an inside liner oriented with tensile strength can be used for example in pressure sewage applications.

Figure 9 shows yet another application of an extrusion apparatus according to the invention. The reference numerals in Figure 9 correspond to those in Figures 1 to 8. A plastic layer is supplied by the extrusion apparatus 19 to the interior of the pipe to be made of the aluminium strip 33. A plastic layer 35 is then supplied on the aluminium pipe with a second extrusion apparatus that is conical. The pipe to be prepared is pulled with a pulling device 36 in such a way that the plastic layer supplied with the extrusion apparatus 34 sticks to the surface of the pipe at a distance from the extrusion apparatus 34. The pulling device 36 can be

rotatably connected. The pulling of the pipe to be prepared succeeds, since due to the layer made of aluminium or some other metal, the pipe stands stretching well. Axial orientation is thus produced in the plastic layer 35. The extrusion apparatus 19 provides inside the aluminium pipe a plastic layer comprising a circumferential orientation. A pipe is thus obtained that comprises an aluminium layer and inside the aluminium layer there is a circumferentially and/or axially oriented plastic layer and outside there is an axially oriented plastic layer, wherefore the resulting pipe is very strong.

Figure 10 schematically shows the use of an extrusion apparatus according to the invention for coating sewage pipes from the inside. The devices required can be installed underground for the interior coating of a sewage pipe 38 via a first drain pit 37a and a second drain pit 37b. The extrusion apparatus 19 is moved in the sewage pipe 38 by pulling it with a cable wire 39. The cable wire 39 is wound on a reel 40. The cable wire 39 is guided by means of control rolls 41. In the case of Figure 10, the extrusion apparatus 19 is first pulled by the cable wire 39 near the first drain pit 37a. The extrusion apparatus is then set into action to produce a plastic pipe 22 and it is pulled with the cable wire 39 towards the second drain pit 37b. The supply of the material and energy to the extrusion apparatus 19 can be realized along a duct 42 from a unit situated on the ground. The extrusion apparatus 19 can naturally also be placed in such a way that it prepares the plastic pipe 22 in the opposite direction as viewed in Figure 10.

The invention is described above by means of only a few preferred embodiments. It is clear for a person skilled in the art, however, that the invention is not restricted to the above examples, but the different

embodiments of the invention may vary within the scope of the appended claims. Therefore, the simplest form of the extrusion apparatus comprises only one fixed stator and one rotatable rotor between which there is a conical feed gap. The method and the apparatus according to the invention can naturally also be used for preparing for example oriented films or high-pressure pipes or hoses.

## Claims

1. An extrusion apparatus for processing plastic material to be extruded, the extrusion apparatus comprising
- at least one stator (1, 6, 10),
  - at least one rotor (2, 2a, 2b),
  - at least one annular feed gap (3) situated between the stator (1, 6, 10) and the rotor (2, 2a, 2b) for the plastic material to be extruded, the diameter of the gap decreasing at least partly continuously in the direction of flow of the plastic material to be extruded, and
  - at least one actuator (5) for rotating the rotor (2, 2a, 2b),
- characterized in that the diameter of the feed gap (3) increases continuously at least at a section of its length in the direction of flow of the plastic material to be extruded.
2. An extrusion apparatus according to claim 1, characterized in that the diameter of the feed gap (3) increases immediately after the rotor (2, 2a, 2b).
3. An extrusion apparatus according to claim 1 or 2, characterized in that the diameter of the feed gap (3) increases linearly.
4. An extrusion apparatus according to claim 1, 2 or 3, characterized in that the end section of the feed gap (3) has a constant diameter.
5. An extrusion apparatus according to claim 1, 2 or 3, characterized in that the feed gap (3) opens on the outer circumference ( $\varnothing_u$ ) of the extrusion apparatus.

6. An extrusion apparatus according to claim 1, characterized in that the actuator (5) provided for each rotor (2, 2a, 2b) with its means for driving the rotor (2, 2a, 2b) is placed at the back of the extrusion apparatus in such a way that it is situated in the radial direction of the extrusion apparatus within the outlines determined by the other components of the extrusion apparatus.

7. An extrusion apparatus according to claim 6, where the extrusion apparatus is connected to operate together for example with a corrugator used in preparing ribbed pipes, characterized in that the extrusion apparatus is placed at least partly inside the corrugator.

8. An extrusion apparatus according to any one of the preceding claims, characterized in that the initial section of the rotor (2, 2a, 2b) has mainly the shape of a tapering cone and the end section of the rotor has mainly the shape of an expanding cone.

9. An extrusion apparatus according to claim 8, characterized in that the end of the rotor (2, 2a, 2b) comprises an area with substantially no grooves.

10. An extrusion apparatus according to any one of the preceding claims, characterized in that the extrusion apparatus comprises at least one intermediate stator (10) comprising in its exterior and interior at least one rotatable rotor, and that the intermediate stator comprises means for heating the material to be extruded from the middle.

11. An extrusion apparatus according to any one of the preceding claims, characterized in that the extrusion apparatus comprises a stator (1, 6, 10) where at least the outer surface is conical, a rotatable outer rotor (2a) placed outside the stator, at least the

inner surface of the rotor being conical, and a rotatable inner rotor (2b) placed inside the stator, and that in connection with the inner rotor (2b) there is a rotatable expansion cone (30), whereupon the end section of the feed gap (3) is formed between the outer rotor (2a) and the expansion cone (30).

12. An extrusion apparatus according to claim 11, characterized in that the extrusion apparatus comprises feeding means for feeding material through the stator (1, 6, 10) separately between the outer rotor (2a) and the stator (1, 6, 10) and between the inner rotor (2b) and the stator (1, 6, 10).

13. An extrusion apparatus according to claim 11 or 12, characterized in that the expansion cone (30) is connected to rotating means (31) with which the expansion cone (30) can be rotated independently of the inner rotor (2b).

14. An extrusion apparatus according to any one of the preceding claims, characterized in that the extrusion apparatus is mounted in bearings from the back so that it is rotatable as a whole.

15. A use of an extrusion apparatus according to claim 6 behind a hole-making machine (20) for example underground, whereupon the extrusion apparatus (19) is arranged to produce a plastic pipe (22) in the hole made by the machine against the soil.

16. A use of an extrusion apparatus according to claim 6 for coating new metal or concrete pipes from the inside.

17. A use of an extrusion apparatus according to claim 6 for recoating from the inside a pipe mounted in place.

18. An extrusion method wherein a product is extruded with an extrusion apparatus comprising at least one stator (1, 6, 10), at least one rotatable rotor (2,

2a, 2b) that is at least partly conical, whereupon at least the surface of the stator (1, 6, 10) situated on the side of the rotor (2, 2a, 2b) is conical at the conical section of the rotor (2, 2a, 2b), so that there is between the stator (1, 6, 10) and the rotor (2, 2a, 2b) an annular feed gap into which the plastic material to be extruded is fed and the diameter of which feed gap (3) decreases at least partly continuously in the direction of flow of the plastic material to be extruded, c h a r a c t e r-i z e d in that the diameter of the feed gap (3) increases continuously at least at a section of its length in the direction of flow of the plastic material to be extruded, whereupon the plastic material is extruded at least at a section of the way outwards under the control of the feed gap (3).

19. A method according to claim 18, c h a r a c t e r i z e d in that the material to be extruded is compressed on the outer circumference ( $\emptyset_u$ ) of the extrusion apparatus.

20. A method according to claim 18 or 19, c h a r a c t e r i z e d in that the extrusion apparatus comprises a stator (1, 6, 10) having at least an outer surface that is conical, a rotatable outer rotor (2a) placed outside the stator and a rotatable inner rotor (2b) placed inside the stator, and that in connection with the inner rotor (2b) there is an expansion cone (30) that is rotated, whereupon the outer rotor (2a) and the expansion cone (30) form between them the end section of the feed gap (3), the material flowing in the gap rotating by the action of the rotors (2a, 2b) and the expansion cone (30).

21. A method according to claim 20, c h a r a c t e r i z e d in that by adjusting the place of the outer rotor (2a) in the radial direction, the thickness of the outer layer of the material (15) to be extruded is adjusted, and by moving the cone (30) in the axial

direction, the thickness of the inner layer of the material to be extruded is adjusted.

22. A method according to claim 20 or 21, characterized in that the material to be extruded is supplied with separate feeding devices separately between the stator (1, 6, 10) and the outer rotor (2a) and between the stator (1, 6, 10) and the inner rotor (2b), and that the properties of the different layers in the product to be extruded are adjusted by regulating the amount of the material flows.

23. A method according to any one of claims 20 to 22, characterized in that the plastic material (15) to be extruded is conducted inside the product to be lined which is formed just before the lining.

24. A method according to claim 23, characterized in that the lining oriented plastic pipe is formed simultaneously with the product to be lined in such a way that the material of the product to be lined is supplied to the mandrel (18) so that the mandrel (18) acts as a point of support.

25. A method according to claim 23 or 24, characterized in that the product to be lined is formed of a strip (32, 33) by winding the strip (32, 33) in the form of a pipe on the lining pipe.

26. A method according to claim 25, characterized in that the strip (32, 33) to be wound is grooved, and the diameter ( $\varnothing r$ ) of the outermost supply flow of the mass (15) to be supplied is greater than the smallest inner diameter ( $\varnothing A1$ ) of the pipe to be formed of the strip (32, 33).

27. A method according to any one of claims 21 to 26, characterized in that a plastic layer (35) is formed on the product to be lined and the product is simultaneously pulled in such a way that the plastic



layer (35) to be supplied by the extrusion apparatus (34) sticks to the surface of the pipe at a distance from the extrusion apparatus (34), so that axial orientation is produced in the plastic layer (35).

5           28. A method according to any one of claims 18 to 20, c h a r a c t e r i z e d in that two different plastic materials are simultaneously pressed on the inner surface of the pipe, whereupon adhesion plastic (25) is pressed on the pipe and for example cross-linked  
10 polyethylene (26) is pressed on the inside of the adhesion plastic.

          29. A method according to claim 28, c h a r a c t e r i z e d in that the adhesion plastic (25) to be pressed is foamed.

15           30. A method according to claim 29, c h a r a c t e r i z e d in that the adhesion plastic (25) contains at least 10%; preferably about 25%, of fine filling agent.

          31. A tubular product made of several different materials, c h a r a c t e r i z e d in that the outer  
20 layer of the product is made of metal or plastic-coated metal, inside which outer layer there is at least one layer of plastic, and between the outer layer and at least one plastic layer there is adhesion plastic (25) which is foamed at least in one intermediate layer.

25           32. A tubular product according to claim 31, c h a r a c t e r i z e d in that the adhesion plastic (25) contains at least 10%, preferably about 25%, of fine filling agent.

          33. A tubular product according to claim 31 or  
30 32; c h a r a c t e r i z e d in that the inner layer of the product is made of radially and/or axially oriented plastic.

          34. A tubular product according to any one of claims 31 to 33, c h a r a c t e r i z e d in that the

foam bubbles of the adhesion plastic (25) are oriented in the radial direction of the pipe.

5           35. A tubular product according to any one of claims 31 to 34, characterized in that the product is joined together with another similar product by means of a cross-linked plastic sleeve (27) that has a diameter compressed to a smaller size than normally.

10           36. A tubular product according to any one of claims 31 to 34, characterized in that the product is joined together with another similar product by means of a sleeve (28) situated inside the joint and a clamping collar (29) situated outside the joint.

15           37. A pipe made of several different materials, characterized in that the innermost layer is a plastic layer (15), outside of which there is an inner electrode layer (32c), outside of which there is an insulating layer (32b), outside of which there is an outer electrode layer (32a).

20           38. A pipe according to claim 37 for conducting gas indoors, characterized in that the electrode layers (32a, 32c) are connected electrically in such a way that the perforation of the electrode layers (32a, 32c) brings about an alarm.

25           39. A pipe according to claim 37, characterized in that the electrode layers (32a, 32c) are connected electrically in such a way that a strain resulting from the loading of the pipe produces a warning signal.

30           40. A pipe according to claim 37, characterized in that the electrode layers (32a, 32c) are connected electrically in such a way that the outer surface of a ventilation or a soil and waste pipe reproduces a sound which is opposite to the signal measured from the inside of the pipe with an overall sound  
35           deadening effect.

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## REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only **U 011574-0**

PCT/EI 5 0 / 0 0 3 5 9	
International Application No.	
20	JUNE 1996 (20-06-1996)
International Filing Date	
The Finnish Patent Office	
PCT International Application	
Name of receiving Office and "PCT International Application"	
Applicant's or agent's file reference	
(if desired) (12 characters maximum)	42802/PCT/TA

<b>Box No. I TITLE OF INVENTION</b> An extrusion apparatus and method, a tubular product, and a pipe	
<b>Box No. II APPLICANT</b>	
Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)</i>  CONENOR OY Kimmeltie 3 FIN-02110 Espoo Finland	<input type="checkbox"/> This person is also inventor.  Telephone No.  Facsimile No.  Teleprinter No.
State (i.e. country) of nationality: FI	State (i.e. country) of residence: FI
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input checked="" type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
<b>Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)</b>	
Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)</i>  KIRJAVAINEN Kari Kivenlahdenkatu 11 A 4 FIN-02320 Espoo Finland	This person is:  <input type="checkbox"/> applicant only <input checked="" type="checkbox"/> applicant and inventor <input type="checkbox"/> inventor only <i>(If this check-box is marked, do not fill in below.)</i>
State (i.e. country) of nationality: FI	State (i.e. country) of residence: FI
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
<input checked="" type="checkbox"/> Further applicants and/or (further) inventors are indicated on a continuation sheet.	
<b>Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE</b>	
The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: <input checked="" type="checkbox"/> agent <input type="checkbox"/> common representative	
Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)</i>  Oy KOLSTER Ab Iso Roobertinkatu 23 P.O.Box 148 FIN-00121 Helsinki Finland	Telephone No. 358-0-618821  Facsimile No. 358-0-602244  Teleprinter No. 122323 KOPAT FI
<input type="checkbox"/> Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.	

Form PCT/RO/101 (first sheet) (5 July 1994; reprint January 1996)

See Notes to the request form

EI 5.2.8.03.7 959.US

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## Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

*If none of the following sub-boxes is used, this sheet is not to be included in the request.*

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

JÄRVENKYLÄ Jyri  
Tapiontie 4  
FIN-15870 Hollola  
Finland

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State (i.e. country) of nationality:

FI

State (i.e. country) of residence:

FI

This person is applicant for the purposes of:

☐ all designated States

☐ all designated States except the United States of America

☒ the United States of America only

☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

This person is:

☐ applicant only

☐ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State (i.e. country) of nationality:

State (i.e. country) of residence:

This person is applicant for the purposes of:

☐ all designated States

☐ all designated States except the United States of America

☐ the United States of America only

☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

This person is:

☐ applicant only

☐ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

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State (i.e. country) of residence:

This person is applicant for the purposes of:

☐ all designated States

☐ all designated States except the United States of America

☐ the United States of America only

☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

This person is:

☐ applicant only

☐ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State (i.e. country) of nationality:

State (i.e. country) of residence:

This person is applicant for the purposes of:

☐ all designated States

☐ all designated States except the United States of America

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☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

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Box No.V DESIGNATION STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

## Regional Patent

- ☒ AP ARIPO Patent: KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AZ Azerbaijan, BY Belarus, KZ Kazakstan, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, DE Germany, DK Denmark, ES Spain, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line) .....

## National Patent (if other kind of protection or treatment desired, specify on dotted line):

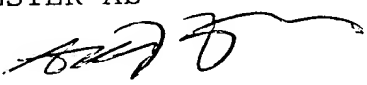
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|--|--|
| <input checked="" type="checkbox"/> AL Albania                                     | <input checked="" type="checkbox"/> MD Republic of Moldova .....                       |
| <input checked="" type="checkbox"/> AM Armenia .....                               | <input checked="" type="checkbox"/> MG Madagascar .....                                |
| <input checked="" type="checkbox"/> AT Austria .....                               | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia ..... |
| <input checked="" type="checkbox"/> AU Australia .....                             |  |
| <input checked="" type="checkbox"/> AZ Azerbaijan                                  | <input checked="" type="checkbox"/> MN Mongolia  |
| <input checked="" type="checkbox"/> BB Barbados                                    | <input checked="" type="checkbox"/> MW Malawi .....                                    |
| <input checked="" type="checkbox"/> BG Bulgaria .....                              | <input checked="" type="checkbox"/> MX Mexico .....                                    |
| <input checked="" type="checkbox"/> BR Brazil .....                                | <input checked="" type="checkbox"/> NO Norway  |
| <input checked="" type="checkbox"/> BY Belarus                                     | <input checked="" type="checkbox"/> NZ New Zealand .....                               |
| <input checked="" type="checkbox"/> CA Canada                                      | <input checked="" type="checkbox"/> PL Poland .....                                    |
| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein        | <input checked="" type="checkbox"/> PT Portugal .....                                  |
| <input checked="" type="checkbox"/> CN China .....                                 | <input checked="" type="checkbox"/> RO Romania   |
| <input checked="" type="checkbox"/> CZ Czech Republic .....                        | <input checked="" type="checkbox"/> RU Russian Federation .....                        |
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| <input checked="" type="checkbox"/> DK Denmark .....                               | <input checked="" type="checkbox"/> SE Sweden  |
| <input checked="" type="checkbox"/> EE Estonia .....                               | <input checked="" type="checkbox"/> SG Singapore                                       |
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| <input checked="" type="checkbox"/> FI Finland .....                               | <input checked="" type="checkbox"/> SK Slovakia .....                                  |
| <input checked="" type="checkbox"/> GB United Kingdom                              | <input checked="" type="checkbox"/> TJ Tajikistan .....                                |
| <input checked="" type="checkbox"/> GE Georgia .....                               | <input checked="" type="checkbox"/> TM Turkmenistan .....                              |
| <input checked="" type="checkbox"/> HU Hungary .....                               | <input checked="" type="checkbox"/> TR Turkey .....                                    |
| <input checked="" type="checkbox"/> IS Iceland                                     | <input checked="" type="checkbox"/> TT Trinidad and Tobago .....                       |
| <input checked="" type="checkbox"/> JP Japan .....                                 | <input checked="" type="checkbox"/> UA Ukraine .....                                   |
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| <input checked="" type="checkbox"/> KG Kyrgyzstan .....                            | <input checked="" type="checkbox"/> US United States of America .....                  |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea ..... |  |
| <input checked="" type="checkbox"/> KR Republic of Korea .....                     | <input checked="" type="checkbox"/> UZ Uzbekistan .....                                |
| <input checked="" type="checkbox"/> KZ Kazakstan .....                             | <input checked="" type="checkbox"/> VN Viet Nam .....                                  |
| <input checked="" type="checkbox"/> LK Sri Lanka                                   |  |
| <input checked="" type="checkbox"/> LR Liberia                                     | Check-boxes reserved for designating States (for the purposes of                       |
| <input checked="" type="checkbox"/> LS Lesotho .....                               | a national patent) which have become party to the PCT after                            |
| <input checked="" type="checkbox"/> LT Lithuania                                   | issuance of this sheet:  |
| <input checked="" type="checkbox"/> LU Luxembourg .....                            | <input checked="" type="checkbox"/> IL... Israel .....                                 |
| <input checked="" type="checkbox"/> LV Latvia                                      | <input type="checkbox"/> .....   |
|  | <input type="checkbox"/> .....   |
|  | <input type="checkbox"/> .....   |

In addition to the designations made above, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except the designation(s) of .....

The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)

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<b>Box No. VI PRIORITY CLAIM</b>		Further priority claims are indicated in the Supplemental Box <input checked="" type="checkbox"/>	
The priority of the following earlier application(s) is hereby claimed:			
Country (in which, or for which, the application was filed)	Filing Date (day/month/year)	Application No.	Office of filing (only for regional or international application)
item (1) FI	(26.06.1995) 26 June 1995	953162	
item (2) FI	(14.12.1995) 14 December 1995	956030	
item (3) FI	(04.04.1996) 04 April 1996	961540	
Mark the following check-box if the certified copy of the earlier application is to be issued by the Office which for the purposes of the present international application is the receiving Office (a fee may be required): <input type="checkbox"/> The receiving Office is hereby requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s): _____			
<b>Box No. VII INTERNATIONAL SEARCHING AUTHORITY</b>			
Choice of International Searching Authority (ISA) (If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used): <u>ISA / SE</u>			
Earlier search Fill in where a search (international, international-type or other) by the International Searching Authority has already been carried out or requested and the Authority is now requested to base the international search, to the extent possible, on the results of that earlier search. Identify such search or request either by reference to the relevant application (or the translation thereof) or by reference to the search request: Country (or regional Office): _____ Date (day/month/year): _____ Number: _____			
<b>Box No. VIII CHECK LIST</b>			
This international application contains the following number of sheets: 1. request : 5 <sup>A</sup> <u>17</u> sheets 2. description : 17 sheets 3. claims : 7 sheets 4. abstract : 1 sheets 5. drawings : 4 sheets Total : <u>34</u> <u>33</u> sheets		This international application is accompanied by the item(s) marked below: 1. <input type="checkbox"/> separate signed power of attorney 2. <input type="checkbox"/> copy of general power of attorney 3. <input type="checkbox"/> statement explaining lack of signature 4. <input type="checkbox"/> priority document(s) identified in Box No. VI as item(s): 5. <input checked="" type="checkbox"/> fee calculation sheet 6. <input type="checkbox"/> separate indications concerning deposited microorganisms 7. <input type="checkbox"/> nucleotide and/or amino acid sequence listing (diskette) 8. <input checked="" type="checkbox"/> other (specify): Copies of Official Actions	
Figure No. <u>1</u> of the drawings (if any) should accompany the abstract when it is published.			
<b>Box No. IX SIGNATURE OF APPLICANT OR AGENT</b>			
Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).			
Oy KOLSTER Ab by  Antti Peltonen			

For receiving Office use only		2. Drawings:  <input type="checkbox"/> received:  <input type="checkbox"/> not received:
1. Date of actual receipt of the purported international application:	20 JUNE 1996 (20. 06. 96)	
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority specified by the applicant: ISA / SE	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid	

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Date of receipt of the record copy by the International Bureau: _____

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## Supplemental Box

If the Supplemental Box is not used, this sheet need not be included in the request.

Use this box in the following cases:

1. If, in any of the Boxes, the space is insufficient to furnish all the information:

in particular:

- (i) if more than two persons are involved as applicants and/or inventors and no "continuation sheet" is available:
- (ii) if, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked:
- (iii) if, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America:
- (iv) if, in addition to the agent(s) indicated in Box No. IV, there are further agents:
- (v) if, in Box No. V, the name of any State (or OAPI) is accompanied by the indication "patent of addition," or "certificate of addition," or if, in Box No. V, the name of the United States of America is accompanied by an indication "Continuation" or "Continuation-in-part":
- (vi) if there are more than three earlier applications whose priority is claimed:

in such case, write "Continuation of Box No. ..." [indicate the number of the Box] and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient;

in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III;

in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;

in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;

in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;

in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;

in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI.

2. If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning non-prejudicial disclosures or exceptions to lack of novelty:

in such case, write "Statement Concerning Non-Prejudicial Disclosures or Exceptions to Lack of Novelty" and furnish that statement below.

## Continuation of Box VI

Country	Filing Date	Application No.	Office of filing
FI	(29.04.1996) 29 April 1996	961822	
SE	(20.09.1995) 20 September 1995	9503272-8	

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## PATENT COOPERATION TREATY

U 011574-0

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION CONCERNING  
SUBMISSION OF PRIORITY DOCUMENTS

(PCT Administrative Instructions, Section 411)

To:

OY KOLSTER AB  
Iso Roobertinkatu 23 12 -09- 1996  
P.O. Box 148  
FIN-00121 Helsinki  
FINLANDE

Date of mailing (day/month/year)

04 September 1996 (04.09.96)

Applicant's or agent's file reference

42802/PCT/TA

## IMPORTANT NOTIFICATION

International application No.

PCT/FI96/00359

International filing date (day/month/year)

20 June 1996 (20.06.96)

Priority date (day/month/year)

26 June 1995 (26.06.95)

Applicant

CONENOR OY et al

The applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to the following application(s):

<u>Priority application No:</u>	<u>Priority date:</u>	<u>Priority country:</u>	<u>Date of receipt of priority document:</u>
953162	26 Jun 1995 (26.06.95)	FI	02 Sep 1996 (02.09.96)
9503272-8	20 Sep 1995 (20.09.95)	SE	02 Sep 1996 (02.09.96)
961540	04 Apr 1996 (04.04.96)	FI	02 Sep 1996 (02.09.96)
961822	29 Apr 1996 (29.04.96)	FI	02 Sep 1996 (02.09.96)

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

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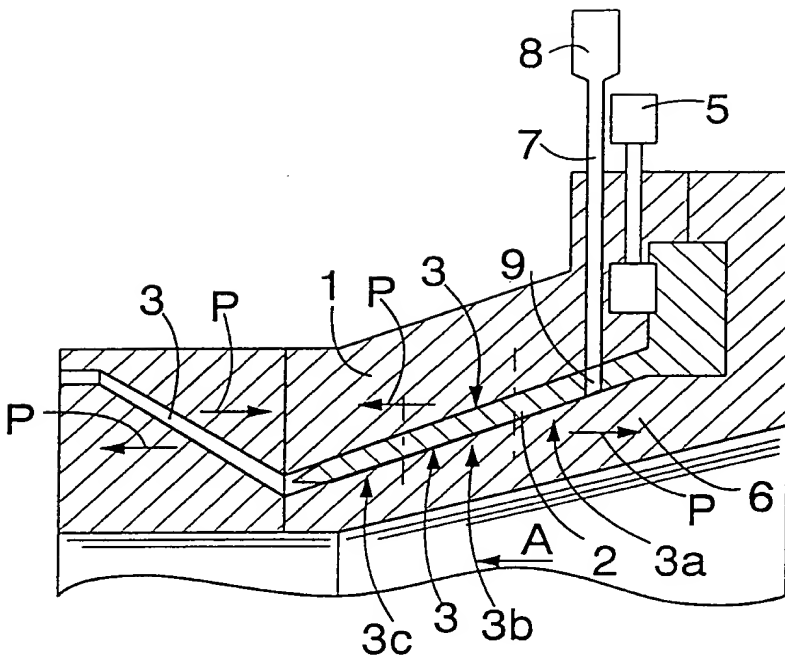


FIG. 1

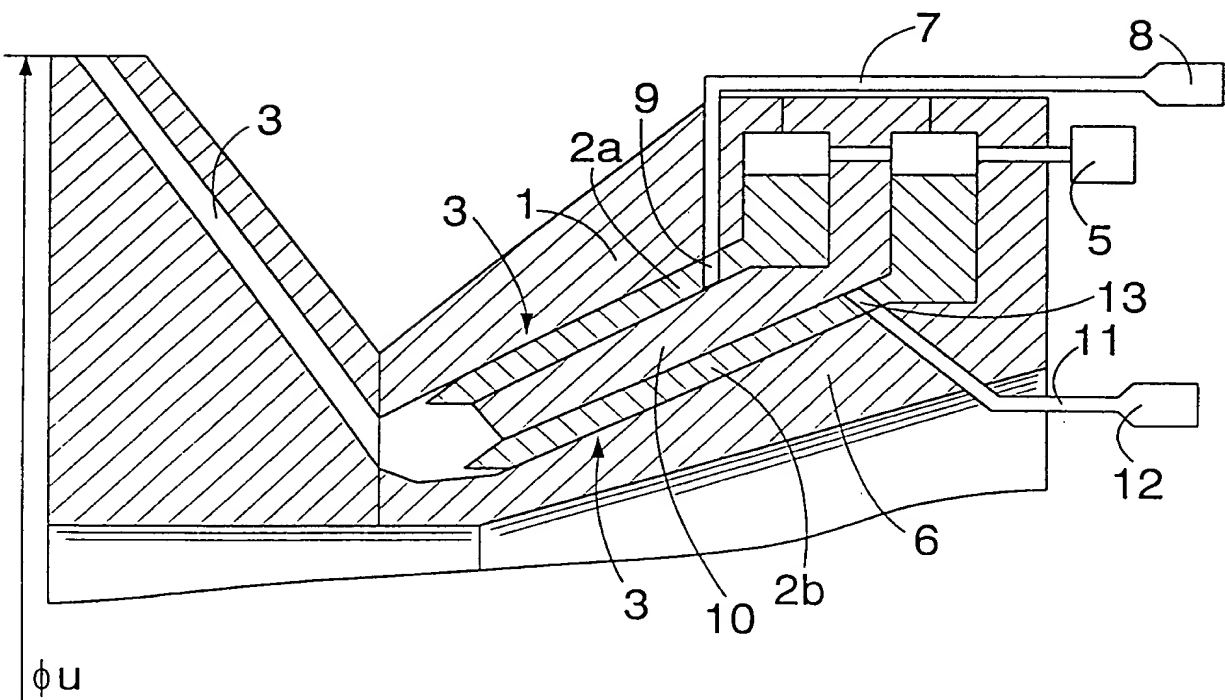


FIG. 2

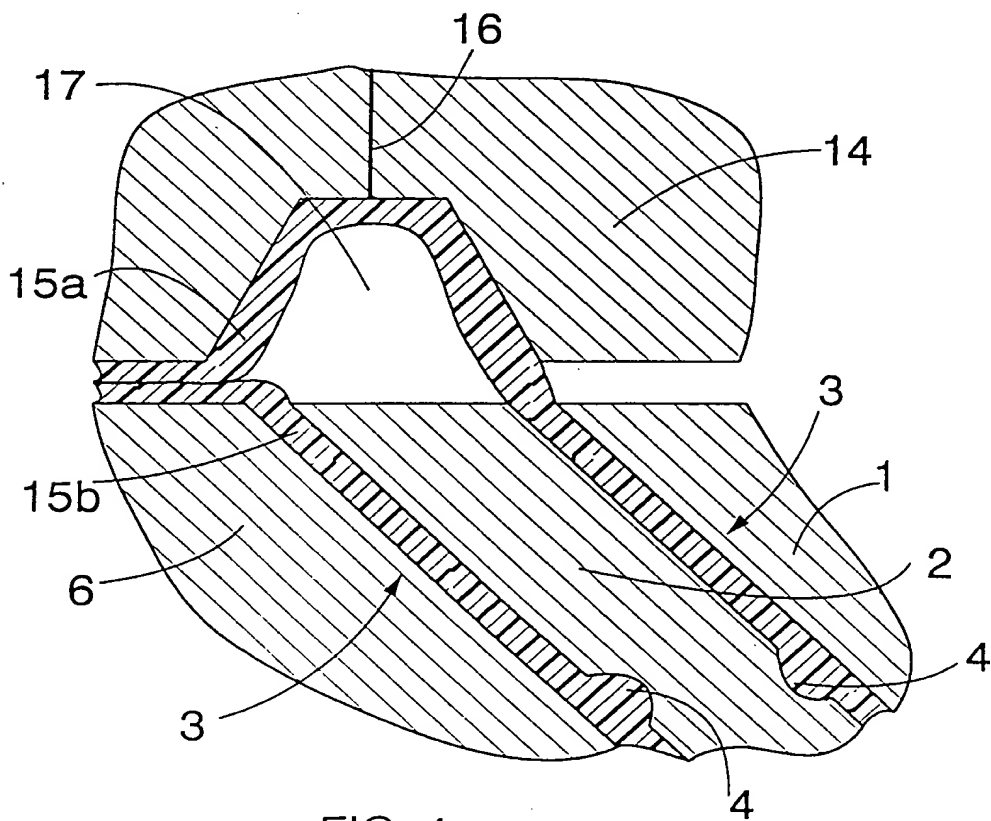
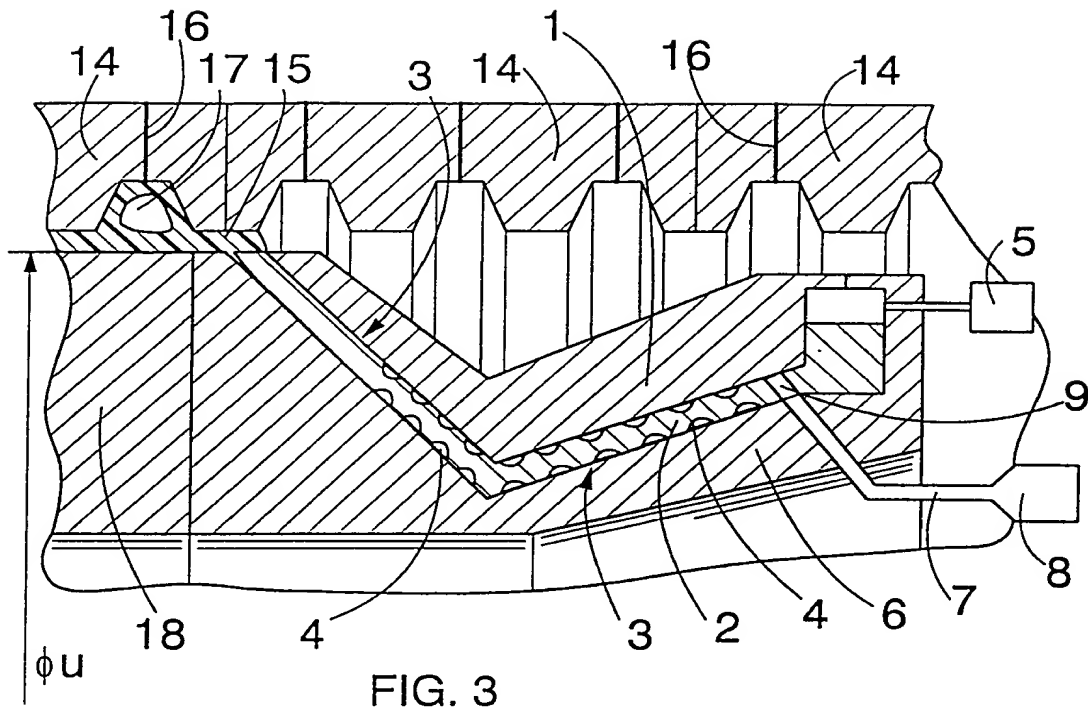
INVENTOR: KARI KIRJAVAINEN, et al

ATTORNEY DOCKET NO.: U 011574-0

SHEET 1 OF 4

EXPRESS MAIL LABEL  
NO.: EI528037945US





INVENTOR: KARI KIRJAVAINEN, et al

ATTORNEY DOCKET NO.: U 011574-0

SHEET 2 OF 4

EXPRESS MAIL LABEL  
NO.: EI528037945US

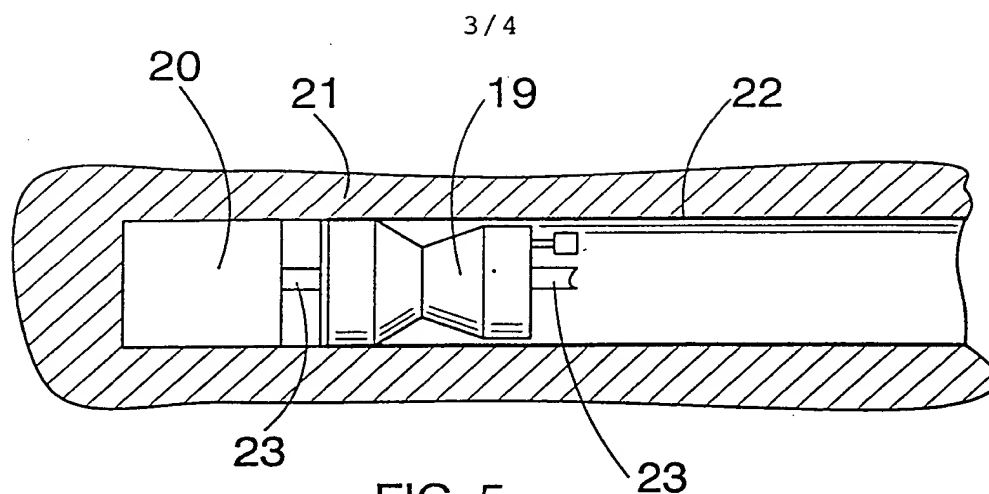


FIG. 5

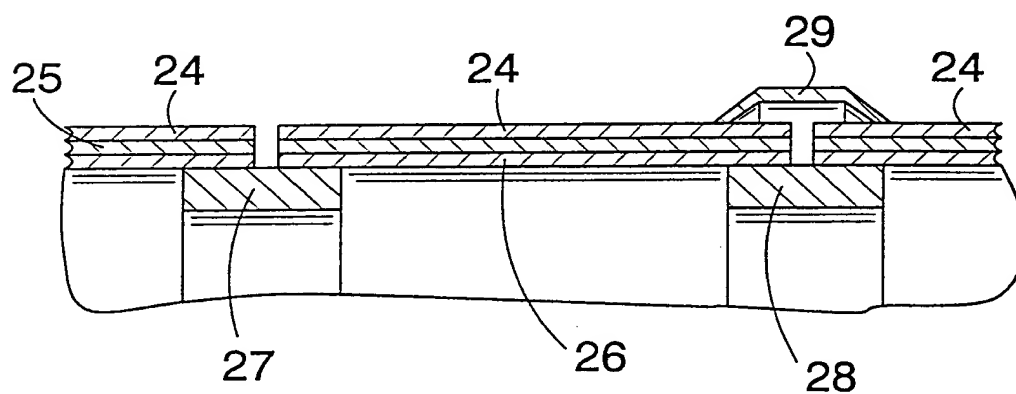


FIG. 6

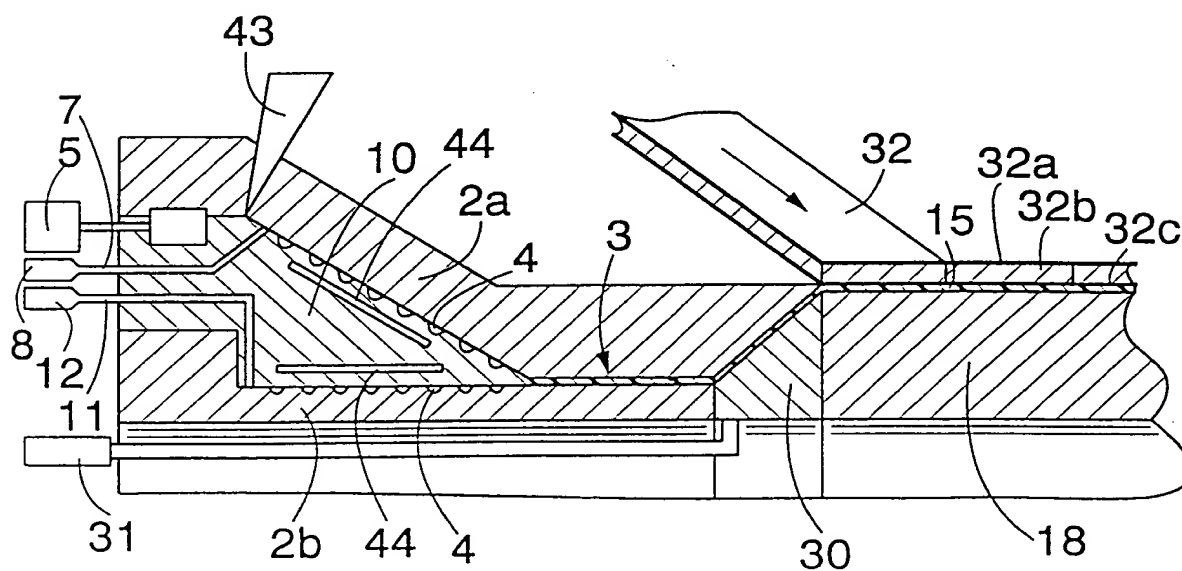


FIG. 7

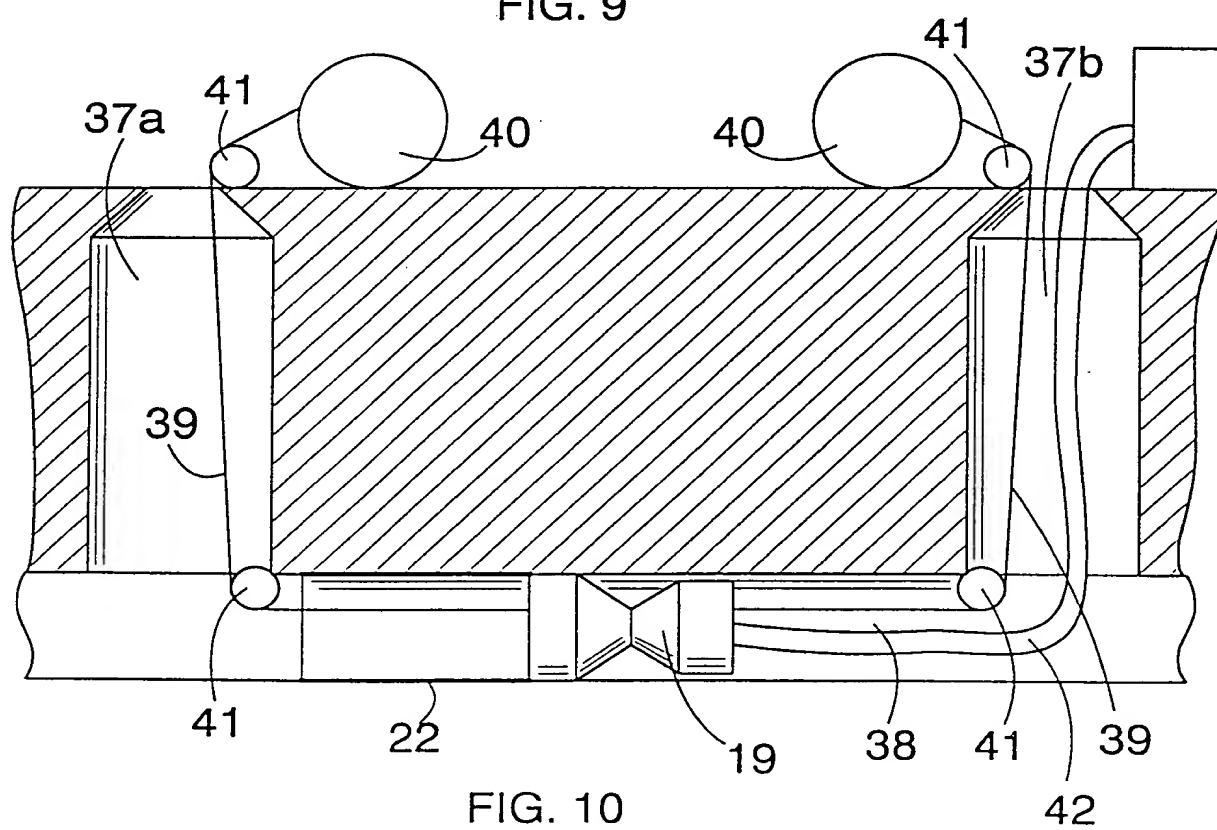
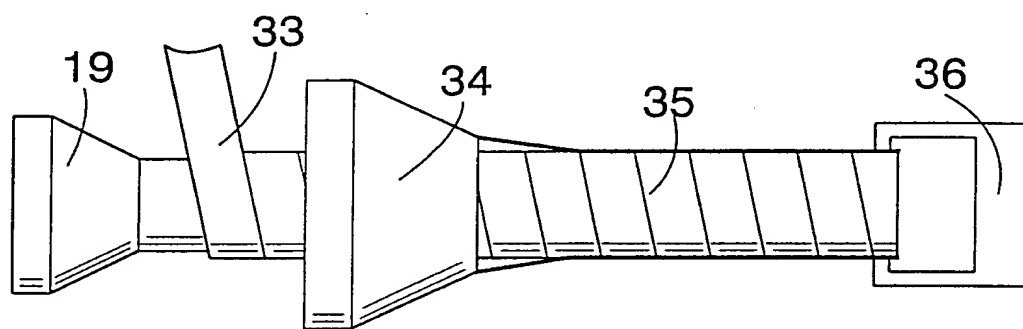
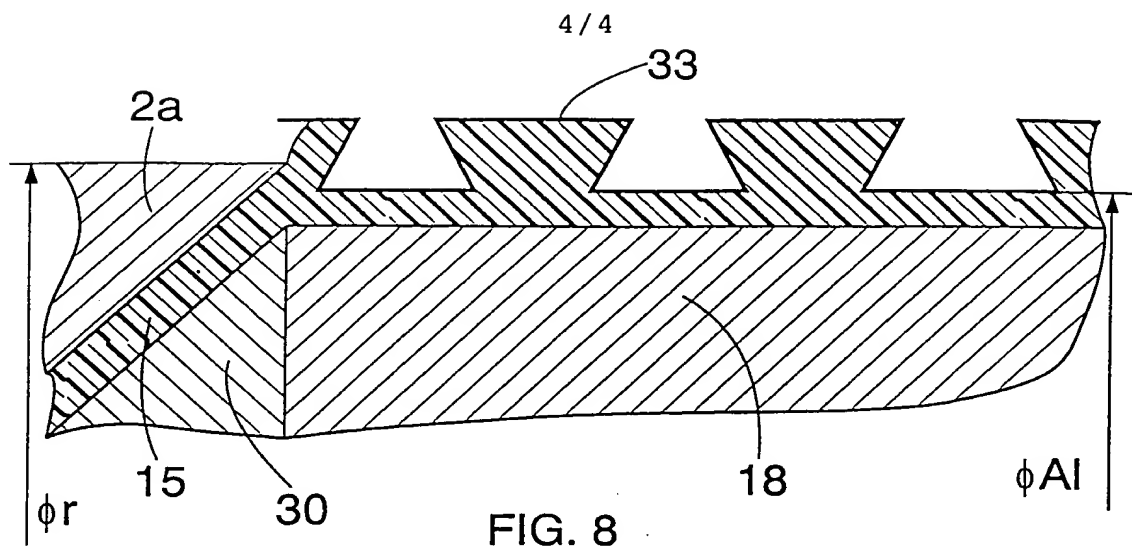
Rec'd PCT/PTO 18 DEC 1997

INVENTOR: KARI KIRJAVAINEN, et al

ATTORNEY DOCKET NO.: U 011574-0

SHEET 3 OF 4

EXPRESS MAIL LABEL  
NO.: EI528037945US



INVENTOR: KARI KIRJAVAINEN, et al

ATTORNEY DOCKET NO.: U 011574-0

SHEET 4 OF 4

EXPRESS MAIL LABEL  
NO.: EI528037945US

## PATENT COOPERATION TREATY

U 011574-0

27-09-1996

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

To:

Oy Kolster AB  
Iso Roobertinkatu 23  
P.O. Box 148  
FIN-00121 Helsinki  
Finland

## INVITATION TO PAY ADDITIONAL FEES

(PCT Article 17(3)(a) and Rule 40.1)

FIRST: 25.10.96 inf. 27/96

Date of mailing  
(day/month/year)

25-09-1996

Applicant's or agent's file reference

42802/PCT/TA

PAYMENT DUE

within 1 months/days  
from the above date of mailing

International application No.

PCT/FI96/00359

International filing date  
(day/month/year)

20-06-1996

Applicant

Conenor Oy et al

## 1. This International Searching Authority

- (i) considers that there are 3 (number of) inventions claimed in the international application covered by the claims indicated below/on an extra sheet:

1-30, 31-36 and 37-40

and it considers that the international application does not comply with the requirements of unity of invention (Rules 13.1, 13.2 and 13.3) for the reasons indicated below/on an extra sheet:

- (ii) ☒ has carried out a partial international search (see Annex) ☒ will establish the international search report on those parts of the international application which relate to the invention first mentioned in claims Nos.:

1-30

- (iii) will establish the international search report on the other parts of the international application only if, and to the extent to which, additional fees are paid.

## 2. The applicant is hereby invited, within the time limit indicated above, to pay the amount indicated below:

6800 SEK x 2 = 13600 SEK  
Fee per additional invention number of additional inventions total amount of additional fees

The applicant is informed that, according to Rule 40.2(c), the payment of any additional fee may be made under protest, i.e., a reasoned statement to the effect that the international application complies with the requirement of unity of invention or that the amount of the required additional fee is excessive.

3. ☐ Claim(s) Nos. \_\_\_\_\_ have been found to be unsearchable under Article 17(2)(b) because of defects under Article 17(2)(a) and therefore have not been included with any invention.

Name and mailing address of the ISA/  
Patent- och Registreringsverket  
Box 5055  
S-102 42 STOCKHOLM  
Facsimile No. 08-666 02 86

Telex  
17978  
PATOREG-S

Authorized officer

Maria Börllin  
Telephone No. 08-782 25 00

Form PCT/ISA/206 (July 1992)

E 15.2.8.0 3.7 959. US

27/9-96/jx

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## Invention 1:

The invention according to claims 1-30 relates to an apparatus and a method for extruding plastic material.

## Invention 2:

The invention according to claims 31-36 relates to a tubular product comprising an outer layer of metal or plastic-coated metal, an inner plastic layer and an intermediate layer consisting of foamed adhesion plastic.

## Invention 3:

The invention according to claims 37-40 relates to a pipe comprising an innermost plastic layer, an inner electrode layer, an insulating layer and an outer electrode layer.

Invention 1 has no technical feature in common with invention 2 or 3. Invention 2 and 3 have no technical features in common, except that they both relates to tubular products made of several different materials.

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COMMUNICATION RELATING TO THE RESULTS OF THE  
PARTIAL INTERNATIONAL SEARCH

International application No.

PCT/FI96/00359

1. The present communication is an Annex to the invitation to pay additional fees (Form PCT/ISA/206). It shows the results of the international search established on the parts of the international application which relate to the invention first mentioned in claims Nos.: 1-30
2. This communication is not the international search report which will be established according to Article 18 and Rule 43.
3. If the applicant does not pay any additional search fees, the information appearing in this communication will be considered as the result of the international search and will be included as such in the international search report.
4. If the applicant pays additional fees, the international search report will contain both the information appearing in this communication and the results of the international search on the other parts of the international application for which such fees will have been paid.

## DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CH 568148 A5 (FRIED. KRUPP GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG), 31 October 1975 (31.10.75), column 6, line 1 - line 10, figure 3	1-5, 18, 19
A	--	6-17, 20-30
A	DE 2051529 A (E.I. DU PONT DE NEMOURS AND CO.), 29 April 1971 (29.04.71), figure 1	1-30
A	DE 2519705 C2 (MFC MASCHINENFABRIK CHUR AG), 18 March 1982 (18.03.82)	1-30
	-- -----	

☐ Further documents are listed in a continuation Box.☒ See patent family annex.

## \* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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**Patent Family Annex**  
Information on patent family members

31/07/96

International application No.

PCT/FI 96/00359

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
CH-A5-	568148	31/10/75	BE-A- 810960	29/05/74
			DE-A- 2308284	05/09/74
			FR-A,B- 2218183	13/09/74
			JP-A- 50040667	14/04/75
DE-A-	2051529	29/04/71	CA-A- 930117	17/07/73
DE-C2-	2519705	18/03/82	NONE	

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## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 42802/PCT/TA	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/FI96/ 00359	International filing date (day/month/year) 20.06.1996	Priority date (day/month/year) 26.06.1995
International Patent Classification (IPC) or national classification and IPC <sub>6</sub> B 29 C 47/24, B 29 C 47/52, B 32 B 1/08, B 32 B 5/18, F 16 L 9/147, F 16 L 9/12, G 01 M 3/18, F 17 D 5/06, G 10 K 11/178		
Applicant Conenor Oy et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 8 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  22.01.1997	Date of completion of this report  21.10.1997
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer  Maria Börllin Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1994)

E I 5.2.8.03.7 959. US

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# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI96/00359

## I Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

- ☐ the international application as originally filed.
- ☒ the description, pages 1-17, as originally filed,  
 pages \_\_\_\_\_, filed with the demand,  
 pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_,  
 pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_.
- ☒ the claims, Nos. \_\_\_\_\_, as originally filed,  
 Nos. \_\_\_\_\_, as amended under Article 19,  
 Nos. \_\_\_\_\_, filed with the demand,  
 Nos. 1-40, filed with the letter of 11.07.1997,  
 Nos. \_\_\_\_\_, filed with the letter of \_\_\_\_\_.
- ☒ the drawings, sheets/fig 1-10, as originally filed,  
 sheets/fig \_\_\_\_\_, filed with the demand  
 sheets/fig \_\_\_\_\_, filed with the letter of \_\_\_\_\_,  
 sheets/fig \_\_\_\_\_, filed with the letter of \_\_\_\_\_.

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/fig \_\_\_\_\_

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI96/00359

## IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☐ restricted the claims.  
☐ paid additional fees.  
☒ paid additional fees under protest.  
☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with rules 13.1, 13.2 and 13.3 is

- ☐ complied with.  
☒ not complied with for the following reasons:

## Invention 1:

The invention according to amended claims 1-30 relates to an apparatus and a method for extruding plastic material. The invention according to amended claims 31-36 relates to a tubular product made by the method.

## Invention 2:

The invention according to amended claims 37-40 relates to a pipe comprising an innermost plastic layer, an inner electrode layer, an insulating layer and an outer electrode layer. The pipe is made by continuous extrusion.

In a single application it is permitted to have an independent claim for a given product, an independent claim for a process specially adapted for the manufacture of the product and an independent claim for an apparatus specifically designed for carrying out the process. Invention I comprises four different categories: an extrusion apparatus, the use of the extrusion apparatus, a method using the apparatus and a product prepared by the method.

.../...

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☒ all parts.  
☐ the parts relating to claims Nos. \_\_\_\_\_

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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI96/00359

**Supplemental Box**

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: IV.

However, in the present application a technical relationship between the method/apparatus according to claim 1 and 18 and the product according to claim 37 is not derivable as the method/apparatus is not specifically designed for manufacturing the product. The apparatus of the present invention could give any tubular product as a result, which product is not at all bound to involve the features of claims 37-40. The fact that the pipe according to claim 37 is logically made by the method of invention I does not imply that the method inherently results in said pipe. Therefore the method of invention I cannot be considered as specially adapted for manufacturing the pipe of claim 37.

Since there exists no common feature which can be considered as a special technical feature within the meaning of PCT Rule 13.2, second sentence, no technical relationship within the meaning of PCT Rule 13 can be seen. Consequently, claims 1-36 and 37-40 do not satisfy the requirement of unity of invention.

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# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI96/00359

## V. Resoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

Novelty (N)	Claims	<u>1-40</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-40</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-40</u>	YES
	Claims		NO

### 2. Citations and explanations

The invention according to amended claims 1-30 filed with the letter of July 11, 1997 relates to an apparatus and a method for extruding plastic material. The extrusion apparatus comprises one stator and one rotor which form an annular feed gap. The diameter of the feed gap decreases and increases in the flow direction of the plastic material. The feed gap is substantially annular throughout the apparatus. The features of the method are the same as of the apparatus.

The invention according to amended claims 31-36 relates to a tubular product made by the method.

Document CH, A5, 568 148 discloses an extrusion apparatus which comprises a rotor and a stator. The rotor and the stator form a feed gap that has a decreasing and increasing diameter. The feed gap is not substantially annular throughout the apparatus.

The invention according to amended claims 1-30 is therefore novel and is considered to involve an inventive step.

It is not totally clear how the apparatus (which is used for carrying out the method) affects the tubular product of claim 31, but it is assumed that the annular feed gap of the apparatus has an influence on the characteristics of the product. The invention according to amended claims 31-36 is therefore novel and is considered to involve an inventive step.

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/FI96/00359

**Supplemental Box**

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V.

The invention according to amended claims 37-40 relates to a pipe comprising an innermost plastic layer, an inner electrode layer, an insulating layer and an outer electrode layer. The pipe is made by continuous extrusion.

Document EP 0 410 503 discloses a cylindrical storage tank comprising isolating plastic layers (I1, I2, I3) and electrode layers (C1, C2). The idea of providing electrode layers between plastic layers is thus known per se. However, the storage tank in document EP 0 410 503 is clearly not extruded.

Document GB 848 423 discloses a pipe comprising non-fibrous materials and electrode layers. There is nothing that indicates that this known pipe could be extruded.

Even if these two documents reveal products with the same design as the product according to claim 37, these products are not prepared by continuous extrusion. The invention according to claims 37-40 is therefore novel and is considered to involve an inventive step.

GB 2 245 977, EP 0 581 566 and abstract of JP 58-27040 are documents defining the general state of the art which are not considered to be of particular relevance.

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11 -07- 1997

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Claims

(amended on July 11, 1997)

- 5                    1. An extrusion apparatus for processing plastic material to be extruded and for extruding hollow products, the extrusion apparatus comprising
- at least one stator (1, 6, 10),
  - at least one rotor (2, 2a, 2b),
  - 10                   - at least one annular feed gap (3) situated between the stator (1, 6, 10) and the rotor (2, 2a, 2b) for the plastic material to be extruded, the diameter of the gap decreasing at least partly continuously in the direction of flow of the plastic material to be extruded,
  - 15                   the feed gap (3) being substantially annular throughout the apparatus, and
  - at least one actuator (5) for rotating the rotor (2, 2a, 2b),
  - c h a r a c t e r i z e d in that the diameter of the
  - 20                   feed gap (3) increases continuously at least at a section of its length in the direction of flow of the plastic material to be extruded.
  - 2. An extrusion apparatus according to claim 1, c h a r a c t e r i z e d in that the diameter of the
  - 25                   feed gap (3) increases immediately after the rotor (2, 2a, 2b).
  - 3. An extrusion apparatus according to claim 1 or 2, c h a r a c t e r i z e d in that the diameter of the feed gap (3) increases linearly.
  - 30                   4. An extrusion apparatus according to claim 1, 2 or 3, c h a r a c t e r i z e d in that the end section of the feed gap (3) has a constant diameter.
  - 5. An extrusion apparatus according to claim 1, 2 or 3, c h a r a c t e r i z e d in that the feed gap (3)

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opens on the outer circumference ( $\emptyset u$ ) of the extrusion apparatus.

5 6. An extrusion apparatus according to claim 1, characterized in that the actuator (5) provided for each rotor (2, 2a, 2b) with its means for driving the rotor (2, 2a, 2b) is placed at the back of the extrusion apparatus in such a way that it is situated in the radial direction of the extrusion apparatus within the outlines determined by the other components of the  
10 extrusion apparatus.

7. An extrusion apparatus according to claim 6, where the extrusion apparatus is connected to operate together for example with a corrugator used in preparing ribbed pipes, characterized in that the  
15 extrusion apparatus is placed at least partly inside the corrugator.

8. An extrusion apparatus according to any one of the preceding claims, characterized in that the initial section of the rotor (2, 2a, 2b) has mainly the shape of a tapering cone and the end section of the  
20 rotor has mainly the shape of an expanding cone.

9. An extrusion apparatus according to claim 8, characterized in that the end of the rotor (2, 2a, 2b) comprises an area with substantially no  
25 grooves.

10. An extrusion apparatus according to any one of the preceding claims, characterized in that the extrusion apparatus comprises at least one intermediate stator (10) comprising in its exterior and  
30 interior at least one rotatable rotor, and that the intermediate stator comprises means for heating the material to be extruded from the middle.

11. An extrusion apparatus according to any one of the preceding claims, characterized in that the extrusion apparatus comprises a stator (1, 6, 10)  
35

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where at least the outer surface is conical, a rotatable outer rotor (2a) placed outside the stator, at least the inner surface of the rotor being conical, and a rotatable inner rotor (2b) placed inside the stator, and that in connection with the inner rotor (2b) there is a rotatable expansion cone (30), whereupon the end section of the feed gap (3) is formed between the outer rotor (2a) and the expansion cone (30).

12. An extrusion apparatus according to claim 11, characterized in that the extrusion apparatus comprises feeding means for feeding material through the stator (1, 6, 10) separately between the outer rotor (2a) and the stator (1, 6, 10) and between the inner rotor (2b) and the stator (1, 6, 10).

13. An extrusion apparatus according to claim 11 or 12, characterized in that the expansion cone (30) is connected to rotating means (31) with which the expansion cone (30) can be rotated independently of the inner rotor (2b).

14. An extrusion apparatus according to any one of the preceding claims, characterized in that the extrusion apparatus is mounted in bearings from the back so that it is rotatable as a whole.

15. A use of an extrusion apparatus according to claim 6 behind a hole-making machine (20) for example underground, whereupon the extrusion apparatus (19) is arranged to produce a plastic pipe (22) in the hole made by the machine against the soil.

16. A use of an extrusion apparatus according to claim 6 for coating new metal or concrete pipes from the inside.

17. A use of an extrusion apparatus according to claim 6 for recoating from the inside a pipe mounted in place.

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18. An extrusion method wherein a hollow product is extruded with an extrusion apparatus comprising at least one stator (1, 6, 10), at least one rotatable rotor (2, 2a, 2b) that is at least partly conical, whereupon at least the surface of the stator (1, 6, 10) situated on the side of the rotor (2, 2a, 2b) is conical at the conical section of the rotor (2, 2a, 2b), so that there is between the stator (1, 6, 10) and the rotor (2, 2a, 2b) an annular feed gap into which the plastic material to be extruded is fed and the diameter of which feed gap (3) decreases at least partly continuously in the direction of flow of the plastic material to be extruded, the feed gap (3) being substantially annular throughout the extrusion, c h a r a c t e r i z e d in that the diameter of the feed gap (3) increases continuously at least at a section of its length in the direction of flow of the plastic material to be extruded, whereupon the plastic material is extruded at least at a section of the way outwards under the control of the feed gap (3).

19. A method according to claim 18, c h a r a c t e r i z e d in that the material to be extruded is compressed on the outer circumference ( $\emptyset u$ ) of the extrusion apparatus.

20. A method according to claim 18 or 19, c h a r a c t e r i z e d in that the extrusion apparatus comprises a stator (1, 6, 10) having at least an outer surface that is conical, a rotatable outer rotor (2a) placed outside the stator and a rotatable inner rotor (2b) placed inside the stator, and that in connection with the inner rotor (2b) there is an expansion cone (30) that is rotated, whereupon the outer rotor (2a) and the expansion cone (30) form between them the end section of the feed gap (3), the material flowing in the gap rotating by the action of the rotors (2a, 2b) and the expansion cone (30).

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21. A method according to claim 20, c h a r a c-  
t e r i z e d in that by adjusting the place of the outer  
rotor (2a) in the radial direction, the thickness of the  
outer layer of the material (15) to be extruded is  
5 adjusted, and by moving the cone (30) in the axial  
direction, the thickness of the inner layer of the  
material to be extruded is adjusted.

22. A method according to claim 20 or 21,  
c h a r a c t e r i z e d in that the material to be  
10 extruded is supplied with separate feeding devices  
separately between the stator (1, 6, 10) and the outer  
rotor (2a) and between the stator (1, 6, 10) and the inner  
rotor (2b), and that the properties of the different  
layers in the product to be extruded are adjusted by  
15 regulating the amount of the material flows.

23. A method according to any one of claims 20  
to 22, c h a r a c t e r i z e d in that the plastic  
material (15) to be extruded is conducted inside the  
product to be lined which is formed just before the  
20 lining.

24. A method according to claim 23, c h a r a c-  
t e r i z e d in that the lining oriented plastic pipe  
is formed simultaneously with the product to be lined in  
such a way that the material of the product to be lined is  
25 supplied to the mandrel (18) so that the mandrel (18) acts  
as a point of support.

25. A method according to claim 23 or 24,  
c h a r a c t e r i z e d in that the product to be lined  
is formed of a strip (32, 33) by winding the strip (32,  
30 33) in the form of a pipe on the lining pipe.

26. A method according to claim 25, c h a r a c-  
t e r i z e d in that the strip (32, 33) to be wound is  
grooved, and the diameter ( $\varnothing$ r) of the outermost supply  
flow of the mass (15) to be supplied is greater than the

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smallest inner diameter ( $\emptyset A1$ ) of the pipe to be formed of the strip (32, 33).

27. A method according to any one of claims 21 to 26, c h a r a c t e r i z e d in that a plastic layer (35) is formed on the product to be lined and the product is simultaneously pulled in such a way that the plastic layer (35) to be supplied by the extrusion apparatus (34) sticks to the surface of the pipe at a distance from the extrusion apparatus (34), so that axial orientation is produced in the plastic layer (35).

28. A method according to any one of claims 18 to 20, c h a r a c t e r i z e d in that two different plastic materials are simultaneously pressed on the inner surface of the pipe, whereupon adhesion plastic (25) is pressed on the pipe and for example cross-linked polyethylene (26) is pressed on the inside of the adhesion plastic.

29. A method according to claim 28, c h a r a c t e r i z e d in that the adhesion plastic (25) to be pressed is foamed.

30. A method according to claim 29, c h a r a c t e r i z e d in that the adhesion plastic (25) contains at least 10%, preferably about 25%, of fine filling agent.

31. A tubular product made of several different materials by a method according to claim 29, c h a r a c t e r i z e d in that the outer layer of the product is made of metal or plastic-coated metal, inside which outer layer there is at least one layer of plastic, and between the outer layer and at least one plastic layer there is adhesion plastic (25) which is foamed at least in one intermediate layer.

32. A tubular product according to claim 31, c h a r a c t e r i z e d in that the adhesion plastic (25) contains at least 10%, preferably about 25%, of fine filling agent.

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33. A tubular product according to claim 31 or 32, characterized in that the inner layer of the product is made of radially and/or axially oriented plastic.

5 34. A tubular product according to any one of claims 31 to 33, characterized in that the foam bubbles of the adhesion plastic (25) are oriented in the radial direction of the pipe.

10 35. A tubular product according to any one of claims 31 to 34, characterized in that the product is joined together with another similar product by means of a cross-linked plastic sleeve (27) that has a diameter compressed to a smaller size than normally.

15 36. A tubular product according to any one of claims 31 to 34, characterized in that the product is joined together with another similar product by means of a sleeve (28) situated inside the joint and a clamping collar (29) situated outside the joint.

20 37. A pipe made of several different materials by continuous extrusion, characterized in that the innermost layer is a plastic layer (15), outside of which there is an inner electrode layer (32c), outside of which there is an insulating layer (32b), outside of which there is an outer electrode layer (32a).

25 38. A pipe according to claim 37 for conducting gas indoors, characterized in that the electrode layers (32a, 32c) are connected electrically in such a way that the perforation of the electrode layers (32a, 32c) brings about an alarm.

30 39. A pipe according to claim 37, characterized in that the electrode layers (32a, 32c) are connected electrically in such a way that a strain resulting from the loading of the pipe produces a warning signal.

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5 40. A pipe according to claim 37, c h a r a c-  
t e r i z e d in the pipe is used as a ventilation or a  
soil and waste pipe and that the electrode layers (32a,  
32c) are connected electrically in such a way that the  
outer surface of the pipe reproduces a sound which is  
opposite to the signal measured from the inside of the  
pipe so that the counter-wave produced in the outer  
electrode layer (32a) muffles the noise occuring inside  
the pipe.

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